

Application No. 10/074,937

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Remarks/Arguments:

In response to the Office Action, the applicants offer the following remarks. Claims 1-12 and 20 are pending. Claims 13-19 have been withdrawn pursuant to a restriction requirement; the applicants confirm their election of claims 1-12 and 20 without traverse. The Office Action rejected claims 1, 3-6, 8-11, and 20 under 35 U.S.C. § 102(e) as anticipated by U.S. Patent Publication No. 2002/0171901 (Bernstein). Claims 1-4, 6-12, and 20 were rejected under 35 U.S.C. § 102(e) as anticipated by U.S. Patent Publication No. 2002/0068170 (Smalley et al.).

I. Examiner Interview

The applicants appreciate the opportunity given their counsel, Kevin R. Casey, to discuss the subject matter of the claimed invention in a telephone interview with Examiner Pak on November 12, 2003. The applicants make the substance of the interviews of record, in compliance with 37 C.F.R. §§ 1.2 & 1.133(b) and M.P.E.P. § 713.04, as follows. Mr. Casey described the claimed invention, discussed the two references applied in the pending Office Action, and highlighted the differences between the references and the claimed invention. Examiner Pak provided helpful comments on the points made by Mr. Casey. The interview concluded with Mr. Casey offering to amend the claims and provide a written response to the Office Action.

II. The Subject Invention

The invention is directed to a composite material formed of single-walled carbon nanotubes and either polymer or silica. The material has been discovered to be useful in nonlinear optical applications and, more particularly, in forming an ultrafast nonlinear all-optical switch. In this application, it is important that the amount of carbon nanotubes be limited, because black carbon substantially absorbs and does not transmit light. A large amount of carbon nanotubes in the composite material would absorb light, causing loss of light and a weaker signal in the switch, thereby decreasing the quality of the switch. Therefore, the polymer or silica component of the composite material must dominate to maximize the optical properties necessary for a quality ultrafast nonlinear all-optical switch. The applicants have

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discovered that it is preferred for the composite material to have a carbon nanotube loading of less than about 0.1 wt %.

III. The Applied References

Bernstein discloses an optical switch comprised of an array of multi-axis magnetically actuated devices. An inner rotational member 3 is nested within an outer rotational member 2 that in turn is nested within a base member 1. The inner rotational member 3 is mounted by two inner torsional flexures 5 to the outer rotational member 2. Similarly, the outer rotational member 2 is mounted by two inner torsional flexures 4 to the base member 1. The torsional flexures 4, 5 may be made of a suitable viscoelastic polymer such as polyimide. The surface 3A of the inner rotational member 3 may comprise a diffraction grating formed by carbon nanotubes. The rotational motions of each rotational member arise in response to an interaction between a magnetic influence and a magnetic moment generated by a current passing through coils 6,7 arranged adjacent to a surface of the inner rotational member 3.

Smalley et al. disclose polymer-wrapped single wall carbon nanotubes. The creation of suspensions of carbon nanotubes with polymeric matrices in composite materials is disclosed. Applications for the materials include non-linear electro-optic devices such as switches.

IV. Lack of Anticipation

The Office Action rejects each of independent claims 1, 6, and 20 under 35 U.S.C. § 102(e) as being anticipated by either the Bernstein reference or the Smalley et al. reference. Anticipation requires that each and every limitation of the claim be disclosed, either expressly or under principles of inherency, in a single prior art reference. *In re Robertson*, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999) (reversing Board's anticipation rejection that was based on principles of inherency); MPEP § 2131. Absence from the reference of any claimed limitation negates anticipation. *Rowe v. Dror*, 42 USPQ2d 1550, 1553 (Fed. Cir. 1997) (preamble claim limitation reciting a balloon angioplasty catheter not anticipated by a general purpose balloon catheter).

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As amended, claims 1, 6, and 20 recite, as one limitation, the composite "having nanotube loading of less than about 0.1 wt %" and a further limitation that the "switch being devoid of any additional electric components." As suggested by the Examiner during the telephone interview, the applicants have amended the independent claims 1, 6, and 20 to more clearly define the structural limitations of an all-optical switch. Neither the Bernstein reference nor the Smalley et al. reference expressly nor under principles of inherency discloses either of these limitations.

Although Bernstein mentions both "polyimide" and "carbon nanotubes," they are mentioned as materials of construction for separate parts of an optical switch. Polyimide is used for flexures 4 and 5, and carbon nanotubes are used for surface 3A. According to Fig. 1A, flexures 4 and 5 and surface 3A are independent parts of the device. Thus, Bernstein does not anticipate a nanotube-polymer (or silica) composite--and certainly not a particular composite having the claimed nanotube loading. At paragraph [0030], Bernstein teaches coating torsional flexures of the multiaxis magnetically actuated device with a layer of suitable viscoelastic polymer to dampen unwanted vibrations of the torsional flexures. At paragraph [0032], Bernstein teaches formation of a diffraction grating surface on the reflective surface. The diffraction grating surface may be formed by growing or depositing structures on the reflective surface. Bernstein discloses examples of structures that can be grown, including carbon nanotubes.

The optical switch taught by Bernstein functions in response to an interaction between a magnetic influence and a magnetic moment generated by a current passing through coils. Bernstein fails to teach or suggest an ultrafast all-optical nonlinear switch. More specifically, Bernstein fails to teach or suggest the claim limitation defining an ultrafast all-optical nonlinear switch as one "devoid of any additional electric components."

In paragraphs 0011 and 0024, Smalley et al. teach non-linear electro-optic devices. The claimed ultrafast all-optical switch is fundamentally different, however, from an electro-optic switch. An electro-optic switch uses an electric field (and the necessary electric components) to switch the optical signal. In contrast, an all-optical switch uses the optical pulse (without any additional electric components) to control the optical signal. Moreover, Smalley et al. have only mentioned the *possibility* of using a polymer-wrapped SWNT as a component even for electro-optic switches. The *feasibility* of such use has not been

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demonstrated either in the published patent application or in any other literature known to the applicants.

Smalley et al. also fail to disclose a composite material comprising nanotubes and polymer or silica, the composite having a nanotube loading of less than about 0.1 wt %. The claimed composite material has the recited characteristics to render it suitable for application as an ultrafast all-optical nonlinear switch. Smalley et al. teach away from such a composite material. Smalley et al. specifically emphasize the amphiphilic and water soluble polymers, see paragraph 0041, which cannot be used for optical fiber applications. The claimed invention specifies (in claims 4 and 9) a polyimide polymer because the claimed composition finds application as the material of construction for an ultrafast all-optical nonlinear switch.

Accordingly, the applicants respectfully submit that neither the Bernstein reference nor the Smalley et al. reference expressly or under principles of inherency disclose all of the limitations recited in the three pending, independent claims. The applied references do not anticipate claims 1, 6, and 20.

V. Conclusion

For all of the foregoing reasons, amended independent claims 1, 6, and 20 are in condition for allowance and would not have been anticipated by either the Bernstein or the Smalley et al. references. Because claims 2-5 and 7-12 depend from a patentable claim, they are also patentable. *See, e.g., In re McCarn*, 101 USPQ 411, 413 (CCPA 1954) ("sound law" requires allowance of dependent claims when their antecedent claims are allowed). Moreover, the subject matter of claims 2-5 and 7-12 is patentable in view of the applied references.

The rejections under 35 U.S.C. § 102(e) should be withdrawn. Favorable action is earnestly solicited. Finally, the Examiner is invited to call the applicants' undersigned representative if any further action will expedite the prosecution of the application or if the Examiner has any suggestions or questions concerning the application or the present Response. In fact, if the claims of the application are not believed to be in full condition for allowance, for any reason, the applicants respectfully request the constructive assistance and suggestions of the Examiner in drafting one or more acceptable claims pursuant to MPEP § 707.07(j) or in

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making constructive suggestions pursuant to MPEP § 706.03 so that the application can be placed in allowable condition as soon as possible and without the need for further proceedings.

Respectfully submitted,

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